**TAC Emergency Conditions List**

Items/Actions Assigned to PDCWG

Discussion Summary from 7/16/21 – 9/8/2021 PDCWG

Updated 9/20/2021

*6 Resource Telemetry: Ensure accurate exchange of Resource telemetry information related to PRC to enhance situational awareness during EEA events.*

Problem – ERCOT currently does not have a way of telling how much generation and how much reserves are being provided by units experiencing a problem. The generator, when trouble shooting the problem, does not have time to adjust every telemetry point and, if they did, would be guesses at best. The generator’s priority in this situation is safety, and then ensuring the plant does not trip offline.

Recommendation – Create a new Resource Status Code (ONHOLD), that would be used to meet the telemetry and COP requirements in NPRR 1085. This status indicates a unit is experiencing an issue, and that all telemetry and capability to follow dispatch are uncertain. ERCOT could decide whether the headroom on ONHOLD units should be included or not in operating reserves. If the ONHOLD status can be automated, it would offer many benefits

Suggestion – ERCOT should investigate additional metrics in addition to PRC that inform operators of grid conditions. Consider changes to the Power Balance Penalty Curve to avoid forgoing actual generation and leaning on Regulating Reserves.

NPRR1085 relates to this topic

*30 Frequency Relay Points: Analyze load shed responsibilities related to frequencies for generation and load and ensure alignment.*

For the PDCWG support of Action Item 30, the issues all relate closely to Action Item 45. The PDCWG feels like it has more of a lead role in Action Item 45, and supporting role in Action Item 30.

Mostly still asking/collecting questions –

* Is 59.3 Hz the optimal value for UFLS (NOGRR 226)? Concerns have been raised by OWG & SPWG for any consideration to change UFLS.
* Should there be additional frequency points where some automatic load shed occurs (59.4)? To be clear and precise, this could be some small fractional load shed – there is no major driver from a PDCWG perspective to change the UFLS. But the PDCWG does believe there could be reliability benefits to an allocation of some amount of automatic load shed at a frequency threshold of 59.40 Hz. The PDCWG is also supportive of any effort to review more holistically the UFLS threshold and the automatic load shed strategies and triggers – PDCWG welcomes a stakeholder collaboration on such and effort.
* What are the risks of damaging generator turbines when frequency remains below 59.4 Hz (refer to Item 45 for some answers)?
* Can FFR frequency triggers be changed and/or tied to ROCOF? (Probably not tied to ROCOF – measurement capabilities are lacking – see NPRR863)
* Is it appropriate and necessary for some Load Shed orders to be allowed up to 30 minutes to execute?

Suggestion – ERCOT could consider sending an RFI to GOs or QSEs to ask about turbine damage risk when operating frequency is below 59.4 Hz.

NOGRR226 relates to this topic, and there may be impacts to PRC-006 and BAL-003 if UFLS is changed.

*44 Ancillary Service Products: Review existing ancillary service products and determine if existing suite of products and amounts is adequate based on lessons learned from the February 2021 winter weather event.*

The PDCWG views this as a very broad issue. PDCWG members agree that the Ancillary Service market design warrants continuous reevaluation. ERCOT’s annual review of A/S Methodology and Implementation discussion, which occurs each September through December, is the best forum for Stakeholders to provide inputs to the A/S product design and procurement strategy.

What about the ongoing ERCOT/consultant study of AS distribution (regional, technology type)? Study results not expected until Q1 2022. The results should be valuable in responding to this issue/question. Nitika will provide status on this study at September PDCWG.

Most PDCWG discussion under this topic revolves around ESRs so far.

Can ESR-RRS deployment and charging rules be improved (refer to Action Item 91 for further comments)?

ROS questions from 7/8 were discussed – the questions directly relate to this topic/issue. It was explained in the 7/16 PDCWG that the PDCWG does not have any tools to assess AS sufficiency – ERCOT brings a summary of results of the Ancillary Service Methodology to PDCWG every fall for review and approval (before going to ROS & TAC), but the tools and analysis are all run by ERCOT.

PDCWG items to consider:

* Consider making RRS a purely frequency responsive service (Reg already is) – i.e. do not release RRS (and Reg) capacity to SCED (similar to treatment once ECRS is implemented).
* Consider procuring additional RRS as Contingency Reserve (until ECRS is implemented) to replenish frequency-deployed RRS and restore frequency. RRS is already held behind the HASL and is a 10-minute energy product (similar to ECRS). This additional RRS (ECRS-equivalent portion) could be released to SCED during capacity scarcity situations.
* ~~Consider a minimum duration limit on ESRs providing (non-FFR) RRS and NSRS.~~ ERCOT does not have visibility into what the state of charge will be on ESRs in upcoming hours and thus does not know whether an ESR will provide RRS from a Gen or CLR side. (ESRs providing RRS switched between Gen and CLR during the Feb 15 frequency event.) Understanding this is crucial to planning how much load needs to be shed in an emergency to create headroom. For every 1 MW switching from Gen to CLR requires an incremental 2 MW of load shed during an emergency, in order to create headroom for the CLR to charge. With some load shed taking up to 30 minutes to perform, it is important to know this amount ahead of time. ~~Combining a minimum duration with restricting manual deployments of RRS will ensure a higher confidence of reserves.~~Therefore, ESRs should not be allowed to switch a PFR-RRS responsibility from Gen to CLR during an EEA or during an RRS deployment.

*45 Frequency: Analyze system frequency leading up to EEA conditions and determine impact of low frequency on generation and load tripping.*

The system frequency and resulting transients were analyzed to evaluate the impact on generation and coordination with load shedding before and during EEA conditions.  Observations include:

The regulation, RRS, FFR, and NON-Spin were exhausted in controlling frequency leading up and into the EEA events. The unstable operating mode momentarily stalled unit response which devalued the PRC.  The inaccurate PRC postponed load shedding efforts needed to maintain minimum stable reserves.

The 59.3 UFLS was not activated since load shedding reached a temporary system balance above the 59.3 Hz setpoint but below the 59.4 Hz automated generation protection trip nine-minute timer setpoint.  The 59.4 Hz unit protection is in place to prevent significant turbine blade and generator end winding damage as the low power frequency excites component mechanical natural frequency.  The extended time of low power frequency will lead to unit damage preventing system recovery after an event.   The mis-coordination of the 59.3 Hz UFLS and 59.4 Hz automated generation trip exposed a vulnerability that needs to be corrected. The cumulative effect of low frequency operation below 59.6 Hz to damage turbine blade is well known and documented in IEEE standards. The damage incurred often is discovered during subsequent maintenance inspections where fatigue cracks are found using nondestructive examination techniques.

After EEA3 was declared, the changing frequency outside the deadband caused the rotating units to start then to reverse turbine governor action which reduced the unit’s ability to respond to further deviations.  The system frequency oscillations interacted with unit control system tuning, creating issues with units being able to maintain a stable operating point. The system frequency oscillations triggered responses from the boiler firing controls, drum level controls, steam temperature controls, and excitation system controls.  In reviewing data from several units, the PDCWG noted oscillations in the power output as well as voltage output due to the frequency oscillations. For steam drum units, the drum level controls are very sensitive to frequency oscillations.  In reviewing data from several units, the PDCWG noted oscillations in drum levels for several units that required manual intervention from plant operators to keep the units on line. However, in at least two cases, units tripped due to boiler overpressure when the drum level controls could not keep up with the frequency oscillations. Other issues noted due to the low frequency were trips on combined cycle units when the low frequency resulted in a reduction in mass air flow, causing MW output reductions or trips due to excessive temperature on superheat tubes.

Recommendations:

1)    ERCOT to perform studies to:

* determine how much regulation service will be needed to preserve a stable frequency
* add a criterion to adjust regulation service procured due to projected adverse weather
* tune Regulation controls to better respond to deviations; this will include normal conditions, daily wind/solar ramps, and abnormal conditions.

2)    ERCOT to review the impact of the impending broadening of governor controls deadband to maintaining stable frequency control.

3)    ERCOT to complete a review and analysis of large load shed increments:

* impact on frequency and system stability (related to ECL 42)
* ERCOT instructed and rotating process (related to ECL 30 & ECL 4)

4)    ERCOT to review the possibility of changing the EEA Triggers to: EEA1 -2700 MW, EEA2 – 2300 MW, and EEA3 - 1750 MW to provide adequate time for recovering reserves.

5)    ERCOT to provide proposals to simplify unit status reporting and critical data that may be needed. It is suggested that terminology be compatible with IEEE 762.  (related to ECL 6)

6)    ERCOT to review PRC calculation methods with PDCWG.  The objective is to investigate more options to improve system reliability with regard to frequency stability and generator telemetry.

**ERCOT frequency control parameters**

59.983 Hz – generator lower deadband

59.91 Hz – automatic deployment of RRS and FRRS-Up

59.85 Hz – automatic deployment of FFR resources

59.80 Hz – automatic deployment of hydro RRS resources operating in synchronous condenser mode

59.70 Hz – automatic deployment of load resources by underfrequency relay

59.40 Hz – Generator underfrequency setpoint (9 minute minimum delay)

59.30 Hz – UFLS relay step 1 (5% of ERCOT load)

*91 Could FFR play a bigger role?*

The February storm was an issue of total sustained generation not being able to meet the load requirements. To that point, ANY additional generation, generation provided AS, or load provided AS could have played a bigger role. However, FFR may have played a role in temporarily arresting frequency during the drop in frequency on 2/15/21 at around 01:45.

Based on potential reliability benefits of FFR in a less severe event, Stakeholders may wish to find an approach that will facilitate increased FFR participation. Additional FFR changes including procurement amounts may need to also be revisited.

ERCOT presentation to PDCWG on 8/11/21 titled “Winter\_Event\_2021\_PDCWG\_08112021\_V2.ppt” describes the reliability benefits of FFR v. Load Resources. The ongoing ERCOT consultant study of Ancillary Services does not address the 450 MW bucket restriction for FFR.

**Background**

The FFR, Fast Frequency Response Ancillary Service product is designed for an eligible Resource provider to discharge in response to frequency trigger of 59.85Hz and the eligible Resource must be capable of providing its FFR responsibility amount for fifteen minutes and then charge for fifteen minutes upon recall of the FFR deployment. ESRs not providing FFR must provide Primary Frequency Response (PFR) at all times. If any ESR were awarded FFR, during the February Winter Event it would not have been providing PFR and thus not discharging until the frequency trigger of 59.85Hz was hit. Thus, FFR would’ve been triggered on 2/15/21 during the most critical time when frequency dropped below 59.85Hz at about 01:45 and there was insufficient fast responding capacity available to arrest frequency. The extent to which FFR would’ve been able to benefit on that day depends on many factors including the amount of ESR capable of providing FFR. The significant frequency drop on 2/15/21 (even though relatively at a slow rate compared to the fast rate of change of frequency (RoCoF) FFR is meant to arrest) only lasted for a few minutes – triggered FFR may have been able to provide critical support during the 5 minutes when frequency was at 59.4Hz - which duration is well within the duration FFR resources are required to sustain response. Therefore, FFR availability on 2/15/21 could’ve provided some benefit during a critical reliability event.

Fast Frequency Response (FFR)

The automatic self-deployment and provision by a Resource of their obligated response within 15 cycles after frequency meets or drops below a preset threshold, or a deployment in response to an ERCOT Verbal Dispatch Instruction (VDI) within 10 minutes. Resources capable of automatically self-deploying and providing their full Ancillary Service Resource Responsibility within 15 cycles after frequency meets or drops below a preset threshold and sustaining that full response for at least 15 minutes may provide Responsive Reserve (RRS).

3.18 Resource Limits in Providing Ancillary Service (3) (d)

The amount of RRS provided from a Resource capable of providing Fast Frequency Response (FFR) must be less than or equal to its 15-minute rated capacity. The initiation setting of the automatic self-deployment of the Resource providing RRS as FFR must be no lower than 59.85 Hz. A Resource providing RRS as FFR that is deployed shall not recall its capacity until system frequency is greater than 59.98 Hz. Once deployed, a Resource telemetering a Resource Status of ONFFRRRS or ONFFRRRSL shall telemeter an RRS Ancillary Service Schedule of zero, and when recalled, such Resource shall telemeter an RRS Ancillary Service Schedule that shall be a non-zero value equal to its RRS Ancillary Service Responsibility. Once recalled, a Resource providing RRS as FFR must restore its full RRS Ancillary Service Resource Responsibility within 15 minutes after cessation of deployment or as otherwise directed by ERCOT.

*100 How did batteries providing FFR perform? Were FFR providers allowed to charge and if not, what penalties did they get charged?*

No ESR had bid for FFR during the time of the Feb 14/15 winter event.

*10X How batteries qualify for AS and the impact of their duration limits.*

ESR qualifications for AS and duration/charging requirements were defined by a set of 9 NPRRs that stakeholders developed in the Battery Energy Storage Task Force.

*10Y Assessment of dynamic stability had the underfrequency relays asserted during the winter storm event. Given the amount of non-underfrequency load shed, the percentage of underfrequency load in-service had increased. If the increased percentage of underfrequency load had been shed would generation remain stable?*

Topic not started yet – can’t find an assignee. And the question seems murky, unclear.